UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
Washington, D.C. 20460

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ENVIRONMENTAL TECHNOLOGY
VERIFICATION PROGRAM

ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM VERIFICATION STATEMENT

TECHNOLOGY TYPE:	**CONE PENETROMETER-DEPLOYED SENSOR**
APPLICATION:	**IN-SITU DETECTION OF PETROLEUM HYDROCARBONS**
TECHNOLOGY NAME:	**RAPID OPTICAL SCREENING TOOL (ROST)**
COMPANY:	**FUGRO GEOSCIENCES, INC.**
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The U. S. Environmental Protection Agency (EPA) has created a program to facilitate the deployment of innovative technologies through performance verification and information dissemination. The goal of the Environmental Technology Verification (ETV) Program is to further environmental protection by substantially accelerating the acceptance and use of improved and more cost effective technologies. The ETV Program is intended to assist and inform those involved in the design, distribution, permitting, and purchase of environmental technologies. This document summarizes the results of a demonstration of a cone penetrometer-deployed Rapid Optical Screening Tool (ROST™) marketed by Fugro Geosciences, Inc.

PROGRAM OPERATION

The EPA, in partnership with recognized testing organizations, objectively and systematically evaluates the performance of innovative technologies. Together, with the full participation of the technology developer, they develop plans, conduct tests, collect and analyze data, and report findings. The evaluations are conducted according to a rigorous demonstration plan and established protocols. EPA's National Exposure Research Laboratory which conducts demonstrations of field characterization and monitoring technologies, selected the U. S. Department of Energy's Sandia National Laboratories as a testing organization.

DEMONSTRATION DESCRIPTION

In May and October, 1995, two cone penetrometer-deployed sensor systems were demonstrated to evaluate how well they could measure subsurface petroleum hydrocarbon contamination. The performance of each system was evaluated by comparing field analysis results to those obtained using conventional sampling and analytical methods. These methods included using a hollow stem auger in conjunction with a split spoon sampler and subsequent analysis of the collected sample by a reference laboratory using EPA Method 418.1 for total recoverable petroleum hydrocarbons (TRPH) and California Department of Health Services Method 8015-Modified for total petroleum hydrocarbons.

The primary objectives of the demonstration were to (1) verify technology performance, (2) determine how well the developer's field instrument performs in comparison to conventional laboratory methods, (3) determine the logistical and economic resources needed to operate the instrument, and (4) produce a verified data set for use in considering the technology for future use in hazardous waste investigations.

Field demonstrations were conducted at two geologically and climatologically different sites: (1) the Hydrocarbon National Test Site located at Naval Construction Battalion Center (NCBC) Port Hueneme, California, and (2) the Steam Plant Tank Farm at Sandia National Laboratories (SNL), Albuquerque, New Mexico. The conditions at each of these sites represent what are considered typical under which the technology would be expected to operate, but are not considered all inclusive. Details of the demonstration, including a data summary and a discussion of results may be found in the report entitled "The Rapid Optical Screening Tool (ROST™) Laser Induced Fluorescence System for Screening Petroleum Hydrocarbons in Subsurface Soil." The EPA document number for this report is EPA/600/R-97/020.

TECHNOLOGY DESCRIPTION

The ROST™ sensor evolved from the tunable laser instrumentation originally developed at North Dakota State University (NDSU) with U.S. Air Force research support. The technology had been commercialized and marketed by a consortium of government and industry led by Loral Corporation and Dakota Technologies. ROST™ was acquired by Fugro Geosciences, Inc., in May 1996 and is now offered as an integrated service with their cone penetrometer (CPT) systems worldwide.

The sensor uses a wavelength tunable ultraviolet laser source coupled with an optical detector to measure fluorescence via optical fibers, a technique known as laser-induced fluorescence spectroscopy (LIF). The measurement is made through a sapphire window on a probe that is pushed into the ground with a truck-mounted cone penetrometer. The optical fibers are integrated with the geotechnical probe and umbilical of the CPT system.

During the period of this demonstration, the ROST™ technology was available for use within the 48 contiguous United States for a cost of approximately $5,300 per day or site-specific footage rates, which includes a CPT rig provided by a commercial vendor. Crew per diem and mobilization costs are additional and site specific. The ROST™ subassembly can be integrated with any commercially available industry-standard CPT rig. Typical crew members include a ROST™ system operator, CPT operator, and an assistant. Under normal conditions, an average of 300 feet of pushes can be completed in a day. This translates to a total cost of under $20 per foot. As of January 1997, Fugro has reduced the cost for the ROST™ and a CPT to approximately $4250 per day.

VERIFICATION OF PERFORMANCE

The findings of the demonstration are as follows:

- The ROST™ system was easily integrated with a conventional cone penetrometer truck. Full integration was accomplished in less than two hours.

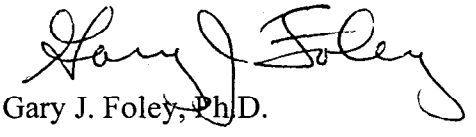
- Data was collected every 0.2 ft. or less if the cone slowed or stopped. Push rate is dependent on the CPT. Standard data collection rate is one sample per 1.2 seconds.

- At Port Hueneme, the correlation with conventional TPH analysis was 89.2% with 5.4% false negatives. At the Sandia tank farm, the TPH correlation was 93.4% with 3.3% false negatives.

- Real time data acquisition was achieved at both sites.

The results of this study satisfied the requirements of the demonstration plan. The ROST™ system successfully located the perimeter of the plume and showed acceptable correlation to conventional methods. The false negative rate combined from both demonstrations was less than 5% and was within the performance specifications of the instrument. Any disagreements with the laboratory results were primarily confined to regions where contaminant concentration levels were close to the detection threshold. A portion of these discrepancies could be the result of variability in laboratory results where random errors are estimated to be in the range of 10 to 15 percent.

The ROST™ system is an emerging technology worthy of consideration for site investigations where aromatic hydrocarbons (e.g., petroleum, oils, lubricants, and coal tars) are suspected. The technology offers a number of advantages over conventional drilling and sampling technologies for the purpose of screening a site to determine the nature and extent of contamination. The information obtained from this technology could provide a complete picture of the contamination and it can be used to predict optimal sampling locations. As with any technology, there are some limitations which a prospective user should be aware when designing an environmental investigation. Stratigraphy and unidentifiable fluorescent interferences are issues that could prevent the sole use of the ROST™ LIF system. The technology has been used to identify lighter fuels but this capability was not evaluated in these demonstrations. Because the technology does not provide species-specific quantitation, it should be used in conjunction with conventional sampling and analysis if risk assessment or cleanup criteria must be met. As a screening technology to identify the nature and extent of aromatic hydrocarbon contamination, this technology has many advantages over conventional techniques.



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